**GROUP OF GOVERNMENTAL EXPERTS OF THE STATES PARTIES TO THE CONVENTION ON PROHIBITIONS OR RESTRICTIONS ON THE USE OF CERTAIN CONVENTIONAL WEAPONS WHICH MAY BE DEEMED TO BE EXCESSIVELY INJURIOUS OR TO HAVE INDISCRIMINATE EFFECTS**

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# Measures to Prevent ERW: Good Practice in Munition Management

Working Paper prepared by the Delegation of the United Kingdom

## 1. Introduction

1. Following the last session of the Group of Governmental Experts in July, we undertook to examine the UK's practices in the field of munitions management in order to establish whether good munition management could bring about a reduction in the instances of unexploded ordnance (UXO).

2. Munitions management is a process that encompasses all the procedures to which a munition is subjected throughout its time in service. These include storage, handling, inspection, testing, and monitoring procedures. The shelf-life of a particular munition is the period within which the munition can continue to be safely and reliably used. Monitoring and testing of the munition throughout its time in service can lead to this time being reduced or extended. Poor munitions management can be costly, detrimental to operational effectiveness and, in the worst cases, can lead to unnecessary injury or loss of life.

3. The UK follows stringent guidelines in munition management, primarily to ensure the safety of personnel, munition storage sites and the surrounding area. Munitions management procedures also help to maintain the reliability of our munitions, therefore reducing the likelihood of munitions not exploding on impact. The purpose of this paper is to facilitate consideration of preventive measures, specifically munitions management, by highlighting some of the factors that can have a negative impact on the reliability, and safety, of munitions, and by outlining some of the principles underlying the techniques that the UK employs to combat these factors.

## 2. Factors that Impact on Munition Reliability

### Environmental Factors

4. The safety, reliability and ultimate shelf-life of a munition is affected by a number of factors. One of the most important is the effects of the environment to which a munition is exposed during its life, be it in storage, during transportation or in use. It is widely accepted that munitions degradation, which invariably adversely impacts on safety and reliability, can be driven by extreme climatic conditions. As such, it is important to establish proactive munitions management regimes from the outset in order to ensure that munitions remain both safe and reliable while in service.

5. The environmental factors which cause deterioration or damage, to which munitions can be exposed as a result of bad handling or storage practices, are:

- Heat
- Extreme cold
- Sudden fluctuations between warm and cold climates, such as experienced in desert conditions
- Humidity or exposure to water
- Prolonged exposure to direct sunlight

6. It is difficult to specify, in a generic way, whether explosive charges and/or fuzing mechanisms of munitions will be degraded by such factors. Such degradation could make munitions less likely to explode on impact, and therefore add to the problem of UXO, and/or could cause munitions to become more unstable, and therefore create an increased hazard for the personnel involved in storing, transporting and handling the munitions. Nevertheless, it is clear that such degradation leads to an increased frequency of munitions not functioning as designed, one of the consequences of which can be that some munitions will not explode on impact. Furthermore, unstable munitions can in themselves be a factor in creating UXO, as an unwanted explosion in a storage site can cause munitions to be propelled over significant distances, some of which will not explode on impact.

7. Larger munitions degraded by the environmental factors listed above can also become UXO as their fuzing mechanisms are often designed to sense environmental criteria such as the application of power, acceleration, time, rotation, removal of safety devices, impact, the target and so on. The intention is that the fuze will only function if all the appropriate conditions are met, otherwise it will actively prevent functioning. This is done in a number of ways, but normally involves a shutter mechanism in the explosive train to prevent initiation of the primary charge. Hence any fault in the system, for example lack of acceleration due to degradation of the propellant charge, will result in the fuze becoming inert. In other words, the munition will be unlikely to explode on impact. Although the fuze has become inert, the unexploded munition still contains large quantities of explosive charge in a potentially dangerous state. In any case, all unexploded ordnance, whether relatively stable or unstable, must be treated as dangerous for clearance purposes, therefore adding to the UXO problem.

**Other Factors**

8. Two significant factors that can have a negative impact on the reliability of munitions, aside from environmental factors are:

- Vibration
- Careless or rough handling

9. Vibration induced fatigue can produce failures in the integrity of munitions' chemical and non-chemical components. One result of this can be a failure of the fuzing mechanism to detonate the munition. Vibration can also result in sudden failures such as the cracking of a warhead high explosive payload.

10. Careless or rough handling can affect the internal mechanisms of components, which cannot be detected. Such damage may render the munition unserviceable or unsafe to use.

## 3. Protection from Factors that Impact on Munition Reliability

### Protection from Moisture

11. Rain, snow and damp cause great and often irremediable damage to munitions in a very short time. The effects of moisture on various types of munitions and associated materials are as follows:

- *Unboxed munition*. The most harmful effect is corrosion. In the latter stages, pitting of the munition may occur to such an extent as to make it unserviceable.
- *Steel containers and their contents.* Exposure to moisture will initially cause steel containers to lose their basic colour and markings. However, eventually they will become perforated, with rapid deterioration of the munition contents following.
- *Explosive compositions*. Some substances used in explosive compositions attract and hold moisture, leading to a reduction or even total loss of the explosive properties. They can also become unserviceable and sometimes dangerous after short periods in damp conditions.
- *Non-explosive materials*. It is important not to store fabrics, felt and paper materials in containers housing munitions as these materials, by absorbing moisture, create conditions favourable to corrosion and decay in other materials in the same container.

12. The simple solution to the effects of moisture is to ensure that munition storage sites are well designed, built and maintained to protect against the access of moisture. Provided this is the case, good ventilation of the munitions will not only keep them cool, but will prevent condensation in and around munition containers and the munitions therein.

### Temperature Considerations

13. Extremes of temperature may affect the performance of solid propellants, such as rocket motors. In munitions with fuzes that are designed to fail-to-safe, this could lead to the munition not exploding on impact. Extremes of temperature can also cause rapid deterioration in explosives, whether the explosives are the fillings of rounds and components or are held in bulk. Specifically, extreme temperatures may cause fillings to melt and distil out chemical constituents. Very low temperatures are not so objectionable, although fracture can occur, particularly when temperature fluctuates between extreme cold and warmth. Furthermore, explosives containing Nitroglycerine can become dangerous at very low temperatures.

14. The temperature of storage areas can be controlled through well made buildings and cooling equipment. However, this is much more difficult to achieve on operational deployment. During short-term operations, munitions are often stored in makeshift storage areas, with some protection from direct sunlight. During longer deployments, munitions are stored in metal containers, which will be ventilated regularly, both to keep the munitions cool and to protect them from humidity.

### Avoidance of Careless Handling and Vibration Induced Fatigue

15. Munition containers are specifically designed to protect munitions during storage and transportation. Damage to a container through careless handling may directly affect the contents. It may also reduce the effectiveness of the protection provided to the contents,

which could consequently deteriorate. Aside from taking care when handling munition containers, it is also important to keep the quantity of opened munition containers to the practicable minimum at all times, as opening the containers immediately lowers the level of protection that munitions receive.

16. Avoiding careless handling is achieved by encouraging high levels of discipline and training among those personnel involved in handling munitions.

17. Vibration induced fatigue is a particular problem for munitions that will be exposed to high levels of vibration. For example, munitions on the wing of an aircraft or in a tracked vehicle. Little can be done to eliminate this problem, except improving the vehicles in which such munitions are carried.

## 4. Logging and Monitoring Munitions

18. Although the negative effects of environmental and other factors on munitions can be controlled, to some extent, through good storage and handling procedures, their effects can not be avoided altogether. This is particularly true in the operational environment. For this reason, the most important aspect of munitions management is the logging and monitoring of munitions. If this is implemented in a rigorous fashion, it is the process most likely to yield improved reliability and safety of munitions, and as such is likely to reduce the instances of munitions not exploding on impact.

19. In the UK, we employ various software packages that log and track all our munitions. However, the principles underlying this process can be implemented without the expense of acquiring and maintaining the necessary hardware and software.

20. Maintaining the identity of munition is extremely important. All British munition packaging is marked with a manufacturers Batch Key Identity (BKI), which gives the date of manufacture and in which batch the munition was produced. If the munition is subsequently found to be faulty, it can easily be withdrawn, and therefore not fired. If a munition loses its identity, through, for example, distortion of the BKI mark due to corrosion, it is withdrawn because its reliability can not be guaranteed.

21. Monitoring and testing are an important part of the management process. As all batches of munitions, or each individual munition in the case of larger munitions, are uniquely identifiable, a record can be made of exactly where they have been, how they have been handled and the environmental factors to which they have been exposed. Munition management specialists are then able to decide whether shelf-life should remain unchanged, be reduced or whether the munition should be withdrawn from service. Testing of individual or batches of munitions is also undertaken regularly, and all munitions returning from operations are thoroughly inspected before being put back into storage. When a munition has reached the end of its shelf-life, or when it is found to be unreliable, it is withdrawn from service and destroyed.

22. Training regimes also contribute to the testing process and help to identify reliability trends. This is particularly relevant with respect to Guided Missiles (GM). Every GM that is fired in training is observed by trained munitions technicians. The missile's serial number is recorded and its performance is noted.

## 5. What are the Benefits from Improved Munitions Management?

23. The benefits from improved munitions management are very clear. Good munitions management will reduce or, if implemented thoroughly, almost completely avoid the risk of catastrophic accidents at storage sites. Accidents such as these obviously damage military effectiveness through loss of munition stockpiles, but much more seriously create a UXO hazard and can also result in loss of life.

24. Good munitions management can lead to improved military effectiveness. First, the discipline required for good munitions management can lead to more effective Armed Forces. Second, if the reliability of munitions is maintained through better munitions management, users of those munitions will need to use fewer of them to achieve the same results.

25. Finally, with specific reference to UXO, the slowing down of the degradation process that can occur as a result of good storage and handling practices will mean that fewer munitions will fail to function as designed. More importantly, by implementing a thorough logging and monitoring process, users can ensure that munitions that have degraded to a point where they are unlikely to function as designed will not be in service.

## 6. Conclusion

26. The main elements of good practice in munitions management are:

- Understanding the factors that can degrade munitions
- Protecting against those factors
- Testing and evaluating munitions
- Logging and tracking munitions
- Acting appropriately on information gained from testing, evaluating, logging and tracking

27. The main benefits of adopting good practice in munitions management are:

- Improved safety
- Improved reliability
- Increased military effectiveness and fewer instances of UXO as a result of improved reliability

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